

CLAIMS

What is claimed is:

1. A method for transferring data from a primary storage controller to a secondary storage controller linked to the primary storage controller by a plurality of links, the method comprising:

- dividing a block of data into a plurality of substantially equal-size tracks;
- receiving a command to transfer the block of data from the primary storage controller to a secondary storage controller;
- allocating memory space in the primary storage controller to a master task control block (TCB) to supervise the transfer of the block of data;
- allocating memory space in the primary storage controller to a plurality of data mover TCBs;
- placing the plurality of data mover TCBs in a queue associated with the master TCB;
- associating a first track of the block of data with a corresponding first data mover TCB of the plurality of data mover TCBs;
- transferring the first track to the secondary storage controller;
- associating a second track of the block of data with a corresponding second data mover TCB of the plurality of data mover TCBs;
- transferring the second track to the secondary controller in a piped fashion relative to the transfer of the first track;
- continuing to associate tracks of the block of data to corresponding data mover TCBs of the plurality of data mover TCBs;
- monitoring the usage of the data mover TCBs; and
- if an insufficient number of data mover TCBs are available to be associated with the remaining tracks of the block of data:
 - directing that the master TCB operate as a data mover TCB; and
 - transferring the remaining tracks of the block of data to the secondary controller serially in a non-piped fashion.

2. The method of claim 1, further comprising continuing to transfer the remaining tracks to the secondary controller in a piped fashion relative to the transfer of the first track if a sufficient number of data mover TCBs are available to be associated with the remaining tracks of the block of data.
3. The method of claim 1, further comprising:
 - monitoring usage of a plurality of links between the primary storage controller and the secondary storage controller; and
 - determining which of the plurality of links is capable of transferring tracks most efficiently.
4. The method of claim 3, further comprising transferring a first group of less than all of the tracks of the block of data to the secondary storage controller over a first most efficient link.
5. The method of claim 4, further comprising:
 - determining if a second link is capable of transferring tracks more efficiently than the first link;
 - transferring a second group of the tracks of the block of data to the secondary storage controller over the second link if the second link is capable of transferring tracks more efficiently than the first link; and
 - transferring the second group of the tracks of the block of data to the secondary storage controller over the first link if the second link is not capable of transferring tracks more efficiently than the first link.
6. The method of claim 5, wherein transferring the second group of tracks over the second link begins following completion of the transfer of the first group of tracks over the first link.

7. The method of claim 5, wherein transferring the second group of tracks over the second link begins prior to completion of the transfer of the first group of tracks over the first link.
8. The method of claim 1, further comprising:
 - receiving the plurality of tracks at the secondary storage controller; and
 - reassembling the block of data from the plurality of tracks.
9. The method of claim 8, further comprising releasing each data mover TCB upon the successful transfer of the associated track to the secondary storage controller.
10. A peer-to-peer remote copy storage system, comprising:
 - a primary storage controller;
 - a secondary storage controller;
 - a plurality of links coupling the primary storage controller with the secondary storage controller;
 - a plurality of substantially equal-size tracks collectively comprising a block of data to be transferred from the primary storage controller to the secondary storage controller;
 - a plurality of data mover task control blocks (TCBs);
 - a master TCB operable to supervise the transfer of the plurality of tracks;
 - means for associating a first track of the block of data with a corresponding first data mover TCB of the plurality of data mover TCBs;
 - means for transferring the first track to the secondary storage controller;
 - the means associating the first track with the first data mover TCB including means for associating a second track of the block of data with a corresponding second data mover TCB of the plurality of data mover TCBs;
 - the means for transferring the first track including means for transferring the second track to the secondary controller in a piped fashion relative to the transfer of the first track;

the means for associating the first track with the first data mover TCB including means for continuing to associate tracks of the block of data to corresponding data mover TCBs of the plurality of data mover TCBs;

means for monitoring the usage of the data mover TCBs; and

if an insufficient number of data mover TCBs are available to be associated with the remaining tracks of the block of data:

means for directing that the master TCB operate as a data mover TCB; and

means for transferring the remaining tracks of the block of data to the secondary controller serially in a non-piped fashion.

11. The system of claim 10, wherein the means for transferring the first track includes means for continuing to transfer the remaining tracks to the secondary controller in a piped fashion relative to the transfer of the first track if a sufficient number of data mover TCBs are available to be associated with the remaining tracks of the block of data.

12. The system of claim 10, further comprising:

means for monitoring usage of a plurality of links between the primary storage controller and the secondary storage controller; and

means for determining which of the plurality of links is capable of transferring tracks most efficiently.

13. The system of claim 12, wherein the means for transferring the first track includes means for transferring a first group of less than all of the tracks of the block of data to the secondary storage controller over a first most efficient link.

14. The system of claim 13, further comprising means for determining if a second link is capable of transferring tracks more efficiently than the first link, wherein:

the means for transferring the first track includes means for transferring a second group of the tracks of the block of data to the secondary storage

controller over the second link if the second link is capable of transferring tracks more efficiently than the first link; and

the means for transferring the first track includes means for transferring the second group of the tracks of the block of data to the secondary storage controller over the first link if the second link is not capable of transferring tracks more efficiently than the first link.

15. The system of claim 14, wherein transferring the second group of tracks over the second link begins following completion of the transfer of the first group of tracks over the first link.

16. The system of claim 14, wherein transferring the second group of tracks over the second link begins prior to completion of the transfer of the first group of tracks over the first link.

17. The system of claim 10, further comprising:

means for receiving the plurality of tracks at the secondary storage controller; and

means for reassembling the block of data from the plurality of tracks.

18. The system of claim 17, further comprising means for releasing the data mover TCBs upon successful transfer of all of the tracks of the block of data to the secondary storage controller.

19. A peer-to-peer remote copy primary storage controller coupled to a secondary storage controller through a plurality of links, the primary storage controller comprising:

a plurality of substantially equal-size tracks collectively comprising a block of data to be transferred from the primary storage controller to the secondary storage controller;

a plurality of data mover task control blocks (TCBs);

a master TCB operable to supervise the transfer of the plurality of tracks;

means for associating a first track of the block of data with a corresponding first data mover TCB of the plurality of data mover TCBs;

means for transferring the first track to the secondary storage controller;

the means associating the first track with the first data mover TCB including means for associating a second track of the block of data with a corresponding second data mover TCB of the plurality of data mover TCBs;

the means for transferring the first track including means for transferring the second track to the secondary controller in a piped fashion relative to the transfer of the first track;

the means for associating the first track with the first data mover TCB including means for continuing to associate tracks of the block of data to corresponding data mover TCBs of the plurality of data mover TCBs;

means for monitoring the usage of the data mover TCBs; and

if an insufficient number of data mover TCBs are available to be associated with the remaining tracks of the block of data:

means for directing that the master TCB operate as a data mover TCB; and

means for transferring the remaining tracks of the block of data to the secondary controller serially in a non-piped fashion.

20. The primary storage controller of claim 19, wherein the means for transferring the first track includes means for continuing to transfer the remaining tracks to the secondary controller in a piped fashion relative to the transfer of the first track if a sufficient number of data mover TCBs are available to be associated with the remaining tracks of the block of data.

21. The primary storage controller of claim 19, further comprising:

means for monitoring usage of the plurality of links; and

means for determining which of the plurality of links is capable of transferring tracks most efficiently.

22. The primary storage controller of claim 21, wherein the means for transferring the first track includes means for transferring a first group of less than all of the tracks of the block of data to the secondary storage controller over a first most efficient link.

23. The primary storage controller of claim 22, further comprising, means for determining if a second link is capable of transferring tracks more efficiently than the first link, wherein:

the means for transferring the first track includes means for transferring a second group of the tracks of the block of data to the secondary storage controller over the second link if the second link is capable of transferring tracks more efficiently than the first link; and

the means for transferring the first track includes means for transferring the second group of the tracks of the block of data to the secondary storage controller over the first link if the second link is not capable of transferring tracks more efficiently than the first link.

24. The primary storage controller of claim 19, further comprising means for releasing a data mover TCB upon the successful transfer of the associated track to the secondary storage controller.

25. A computer program product of a computer readable medium usable with a programmable computer, the computer program product having computer-readable code embodied therein for transferring data from a primary PPRC storage controller to a secondary storage controller over any of a plurality of links, the computer-readable code comprising instructions for:

dividing a block of data into a plurality of substantially equal-size tracks;

receiving a command to transfer the block of data from the primary storage controller to a secondary storage controller;

allocating memory space in the primary storage controller to a master task control block (TCB) to supervise the transfer of the block of data;

allocating memory space in the primary storage controller to a plurality of data mover TCBs;

placing the plurality of data mover TCBs in a queue associated with the master TCB;

associating a first track of the block of data with a corresponding first data mover TCB of the plurality of data mover TCBs;

transferring the first track to the secondary storage controller;

associating a second track of the block of data with a corresponding second data mover TCB of the plurality of data mover TCBs;

transferring the second track to the secondary controller in a piped fashion relative to the transfer of the first track;

continuing to associate tracks of the block of data to corresponding data mover TCBs of the plurality of data mover TCBs;

monitoring the usage of the data mover TCBs; and

if an insufficient number of data mover TCBs are available to be associated with the remaining tracks of the block of data:

directing that the master TCB operate as a data mover TCB; and

transferring the remaining tracks of the block of data to the secondary controller serially in a non-piped fashion.

26. The computer program product of claim 25, further comprising instructions for continuing to transfer the remaining tracks to the secondary controller in a piped fashion relative to the transfer of the first track if a sufficient number of data mover TCBs are available to be associated with the remaining tracks of the block of data.

27. The computer program product of claim 25, further comprising instructions for:

monitoring usage of the plurality of links between the primary storage controller and the secondary storage controller; and

determining which of the plurality of links is capable of transferring tracks most efficiently.

28. The computer program product of claim 27, further comprising instructions for transferring a first group of less than all of the tracks of the block of data to the secondary storage controller over a first most efficient link.
29. The computer program product of claim 28, further comprising instructions for:
- determining if a second link is capable of transferring tracks more efficiently than the first link;
 - transferring a second group of the tracks of the block of data to the secondary storage controller over the second link if the second link is capable of transferring tracks more efficiently than the first link; and
 - transferring the second group of the tracks of the block of data to the secondary storage controller over the first link if the second link is not capable of transferring tracks more efficiently than the first link.
30. The computer program product of claim 25, further comprising instructions for:
- receiving the plurality of tracks at the secondary storage controller; and
 - reassembling the block of data from the plurality of tracks.
31. The computer program product of claim 30, further comprising instructions for releasing each data mover TCB upon the successful transfer of the associated track to the secondary storage controller.